PEDESTRIAN AND TRAFFIC SAFETY
COMMITTEE MEETING

Multiple Threat Pedestrian Crash Scenarios
Meeting Minutes
February 28th, 2017

ATTENDEES

<table>
<thead>
<tr>
<th>Name</th>
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<tr>
<td>Brent Clark</td>
<td>SRF</td>
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<tr>
<td>Joe Gustafson</td>
<td>Washington County</td>
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<td>Jasna Heidzic-Stanek</td>
<td>MnDOT</td>
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<td>Chad Jorgenson</td>
<td>SEH</td>
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<td>Tyler Krage</td>
<td>Alliant Engineering</td>
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<td>Sam Markman</td>
<td>SRF</td>
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<td>Tom Sachi</td>
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<td>Stephen Smith</td>
<td>Alliant Engineering</td>
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<tr>
<td>Caitlin Wotruba</td>
<td>Kimley-Horn</td>
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MEETING LOCATION: Kimley-Horn

I. Committee Updates
- Looking for INCITER Ped/Safety Committee Technical article for May edition

II. Multiple Threat Pedestrian Crash Scenarios
Joe Gustafson lead the presentation with a spreadsheet tool and a discussion.

Multiple Threat Pedestrian Crash Information-
- Often occurs at two-lane approaches of unsignalized intersections, where one vehicle stops to allow pedestrian to cross and another passes or doesn’t see pedestrian, followed by crash.
- Initial motorist may wave for pedestrian to cross, as a result pedestrian may increase pace of walking
- Crashes with pedestrian and second vehicle are often high-severity or fatal
- Crash largely occurs from poor sight distance of second vehicle around stopped vehicle
- “What speed would the second vehicle need to travel in order to stop in time for crash prevention?”
Multiple Threat Crash Analysis Tool (MTCAT)-

- Joe developed a tool as a thought exercise to answer that question.
- Simulates crossing using pedestrian and vehicle speeds
- Makes base assumptions:
  - Solid box shaped car (can’t see through)
  - Pedestrian has a constant walking speed
  - Vehicle breaking crosswalk threshold = Crash
  - Variable = reaction time, driving speed, pedestrian walking speed, sight distance angles, braking speeds, crosswalk width, lane width, etc.
- Results in vehicles needing to travel 3-13 mph to avoid hitting pedestrian (unrealistic to slow that speed every time a vehicle is stopped?)

Strategies-

- Effective strategies to help fix problem:
  - 4-3 Lane road diet (at times)
  - HAWK signal
  - Beacons
  - Pedestrian and community education (check both lanes before fully crossing)
  - Advance stop bars

- Ineffective strategies to help fix problem:
  - High speeds
  - Narrow lanes (in this crash type, narrow lanes may give less time to react)
  - MN nice (waving pedestrians to cross when they may not be comfortable crossing)
  - Increased signage and markings (may add distraction to driver, increasing reaction time)

MTCAT Implementation Possibilities-

- Tool started out as a simple thought exercise on how to fix crash scenario
- May lead to a priority list of decreasing distractions at certain intersections
- Can show just how important pedestrian and community education play a role in helping to mitigate certain crashes
- Serves as a good visual/demonstration for issues to council and policy makers
Discussion Points-
- Multi-roundabouts may have same type of issue for pedestrian crossings
- Need to be careful when addressing mitigation plans to avoid victim-blaming while still showing pedestrian caution may be best route in reducing this crash type
- Does mitigation and initial crash issue differ by culture and demographics?
- Tool can be great asset for political education and corridor planning

III. Round Robin

Jansa- MnDOT Share the Road Campaign is nearing end, looking to hear feedback

NEXT Ped/Safety MEETING:

Date: Wednesday, March 15th (1:00-2:30pm)

Location: St. Paul Western District Police station

Topic: Stop For Me Campaign and Toward Zero Deaths presentation

Minutes Submitted By: Tyler Krage
Multiple Threat Crosswalk Analysis Tool (MTCAT)

Joe Gustafson, PE, PTOE
NCITE Pedestrian Committee
February 28th, 2017
Multiple Threat Crashes
Multiple Threat Crashes
Multiple Threat Crashes

• Pedestrians, too often, do NOT adequately check the next lane
• Usually the inner lane, but not always
• Most crosswalks are at intersections
  – Stopping vehicles can be mistaken for turning vehicles
  – State law prohibits passing another vehicle that is yielding to a pedestrian, but the pedestrian may not be visible
Markings Reduce Safety

A tragic pattern

• May 2014 - Snelling Ave
  – Divided multi-lane road
  – Jetta passed sport utility vehicle
  – SUV driver “waved” pedestrians across
  – Two Macalester students severely injured

• October 2014 – Rice Street
  – Car in right lane stopped, left lane did not
  – 11 year-old boy severely injured
A tragic pattern

• March 2016 – Kellogg Blvd
  – Dark, rainy. Divided multi-lane road
  – Car in right lane stopped, SUV in left lane did not
  – Daughter killed, mother injured

• May 2016 - Maryland Ave
  – Prius passed box truck and struck woman
  – Truck driver “waved” pedestrians across
  – Prius driver thought truck was turning
A tragic pattern

• In all four cases:
  – No shoulders
  – 1\textsuperscript{st} driver appears to have stopped when the pedestrian was not within the roadway
  – Pedestrians may have otherwise been waiting for a clear gap
  – Pedestrians did not adequately check the adjacent lane.
ST. PAUL

Woman waved by motorist to cross St. Paul street is hit by 2nd driver, severely hurt

The woman has severe head injuries that are life-threatening, according to police.

By Paul Walsh Star Tribune | MAY 23, 2016 — 5:28PM

A woman who got a wave from one motorist to go ahead and cross a St. Paul street was hit by a driver in another vehicle and critically injured Monday morning, police said.

For any motorist approaching an intersection, “if you see a car in the right-hand lane putting its brakes on and you see those brake lights, you need to be aware and ask why is that car stopping,” Linders said. “Be curious.”
How Slow is Slow Enough?

The MTCAT spreadsheet makes it possible to calculate the maximum vehicle speed at which a driver is able to react and avoid colliding with a pedestrian who is crossing at a constant speed.
How Slow is Slow Enough?

• MTCAT spreadsheet uses a few basic assumptions:
  – Vehicles are box-shaped, and tall
    • Ignores rounded vehicle corners.
    • Assumes it’s not possible to see under or over.
    • BUT, many vehicles do fit this description.
  – The pedestrian crosses at a constant speed and does not check the adjacent lane for traffic.
  – Any crosswalk intrusion = presumed crash
How Slow is Slow Enough?

• MTCAT spreadsheet allows for many variables!
  – PIEV (“perception-reaction”) time
  – Deceleration rate
  – Crosswalk user speed
  – Crosswalk width
  – Lane Width
  – Vehicle width
  – Advance stopping position
  – And more
**Input Screen**

Crosswalk Multiple-Threat Scenario for a crosswalk user who does not first check for a safe gap in the adjacent lane.

Instructions: See "Illustration of Variables" Worksheet Tab and enter variables in green boxes. See below and "Table Output" tab for results.

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<td>$V_s$</td>
<td>mph</td>
<td>Initial Speed of moving vehicle. (Higher = Greater Risk)</td>
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<td>7</td>
<td>$W_{MV}$</td>
<td>ft</td>
<td>Width of moving vehicle (7 ft for car, 8.5 ft for transit bus, Wider = Greater Risk)</td>
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<td>12</td>
<td>$W_{LV}$</td>
<td>ft</td>
<td>Lane Width in lane of moving vehicle (10-12 ft typical. Narrower = Greater Risk)</td>
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<td>Width of stopped vehicle (7 ft for car, 8.5 ft for transit bus, Wider = Greater Risk)</td>
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<td>Lane Width in lane of stopped vehicle (10-12 ft typical. Narrower = Greater Risk)</td>
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<td>6</td>
<td>$L_{SB}$</td>
<td>ft</td>
<td>Length of vehicle setback (distance from edge of crosswalk to front of the stopped vehicle (5 ft typical, otherwise distance from crosswalk to advance stop line)</td>
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<tr>
<td>1.33</td>
<td>$D_{DO}$</td>
<td>ft</td>
<td>Driver Offset (distance from center of vehicle to center of driver's seat, in feet, 1.33 ft typical)</td>
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<tr>
<td>4.5</td>
<td>$W_{S}$</td>
<td>ft</td>
<td>Crosswalk Width (6 ft typical. Narrower = Greater Risk)</td>
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<tr>
<td>4.5</td>
<td>$V_{S}$</td>
<td>ft/s</td>
<td>Crosswalk User Speed (8.8 ft/s for jogging, 4.5 ft/s typical 50%ile walking, 3.5 ft/s used for ped interval. Faster Crosswalk User Speed = Greater Risk)</td>
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<tr>
<td>18.5</td>
<td>$G_{max}$</td>
<td>%</td>
<td>% Grade in direction of crosswalk approach (Enter as number, e.g. 0.50. Negative = Downhill)</td>
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<tr>
<td>2.6</td>
<td>$E_P$</td>
<td>sec</td>
<td>&quot;Seat of the Pants&quot; emergency braking deceleration rate (ft/s²), relative to road surface. See <a href="http://safety.fhwa.dot.gov/speeding/gif/rpmats/hwasa1222/chap_2.cfm">http://safety.fhwa.dot.gov/speeding/gif/rpmats/hwasa1222/chap_2.cfm</a> 15-20 ft/s² per NACTO</td>
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**Fixed Values:**

- 32.2 g/ft²: Gravitational Acceleration (32.2 ft/s²)
- $V_f$ mph: Final speed of moving vehicle upon completion of braking maneuver (mph). Fixed at Zero for Stopping Condition.

**Calculated Values for Initial Speed Entered Above (See "Table Output" tab for table of all other initial speeds)**

- 51.33 ft/s: Initial Speed of moving vehicle in ft/s
- 0.00 ft/s: Final Speed of moving vehicle in ft/s
- 0.00 g: Angle of Approach Grade Relative to Horizontal Plane (degrees)
- 18.53 ft/s²: Sliding Acceleration due to Gravity (g sin φ) (Positive values indicate driver feeling pulled towards the front of the car)
- 5.27 sec: Time (s) from when the brakes are applied to when $V_f$ is reached. Does not include PEV time. Time from when the brakes are applied to when $V_f$ is reached INCLUDING PEV time.
**Output Screen**

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<th>Final Speed mph</th>
<th>$\Delta t_{x\text{sec}}$ sec</th>
<th>$\Delta t_{y\text{sec}}$ sec</th>
<th>$d_{\text{access}}$ ft</th>
<th>$d_{\text{leaving}}$ ft</th>
<th>$\alpha_{\text{access}}$ rad</th>
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The results are frightening

• Consider the following situation:
  – 11 ft lanes
  – 7 ft wide moving car, 7 ft stopped SUV
  – Stopped SUV is 5 ft from the crosswalk
  – Crosswalk is 6 ft wide
  – Pedestrian moving at 4.5 ft/s (Average)
  – Flat grade, locked-wheel braking (0.57G)
  – 2.5 second PIEV (Normal value = 2.5 sec)
  – A driver traveling at just 3 MPH will be unable to avoid hitting the pedestrian!
The results are frightening

- Second example:
  - 12 ft lanes
  - 7 ft wide moving car, 7 ft stopped SUV
  - Stopped SUV is 5 ft from the crosswalk
  - Crosswalk is 6 ft wide
  - Pedestrian moving at 4.0 ft/s (old MUTCD)
  - Flat grade, locked-wheel braking (0.57G)
  - 1.5 second PIEV (Normal value = 2.5 sec)
  - A driver traveling at just 8 MPH will be unable to avoid hitting the pedestrian!
The results are frightening

• Third (urban) example:
  – 10.5 ft lanes
  – 7 ft wide moving car, 8.5 ft stopped bus
  – Stopped bus is 5 ft from the crosswalk
  – Crosswalk is now 8 ft wide
  – Pedestrian moving at 3.5 ft/s (slow!)
  – Flat grade, locked-wheel braking (0.57G)
  – 0.65 second PIEV (Normal value = 2.5 sec)
  – A driver traveling at just 13 MPH will be unable to avoid hitting the pedestrian!
We need to ask…

How often do you pass a stopped vehicle?
A slowing vehicle?
A turning vehicle?
A transit bus?

Is it realistic to expect that we can condition drivers through education and/or enforcement to slow down enough, every time?
What Won’t Work

• More signs, bigger signs, brighter signs
• More markings, bigger markings, brighter markings
• Misleading education campaigns
  – Waving pedestrians into the street induces more multiple-threat situations.
  – Even the most well-educated driver would still be unable to stop at these speeds.
  – It’s not about who has the right-of-way, it’s about visibility and reaction time.
When facing traffic, a friendly wave can be deadly

As a St. Paul tragedy shows, all must take heed at crossings.

By Brendan Kennealy | JUNE 3, 2016 — 6:38PM

http://www.startribune.com/when-facing-traffic-a-friendly-wave-can-be-deadly/381831081/
What Makes Things Worse

- Faster pedestrians (and bicyclists)
- Narrower lanes
  - Shortens overall crossing distance, BUT
    - Reduces the available sight triangle
  - Narrower lanes might reduce speeds, BUT
    - 10 ft lanes won’t make drivers go 10 mph
- Narrower crosswalks (small effect)
- Wider vehicles
- Downhill approach grades
What Could Help

• Stopping further in advance of xwalk
• Active traffic control devices
  – Warning beacons
  – RRFB
  – Pedestrian Hybrid Beacons (HAWK)
  – Signalized crosswalks (R-Y-G lights)
  – Signalized intersections
• Pedestrian education (check each lane)
• 3-Lane Road Diets (sometimes)
3-Lane Road Diets

• CAN work over 15,000 vehicles per day
  – Won’t work quite as well, BUT
  – Four-lane undivided doesn’t work well either

• Multiple-threat crash IS still possible
  – Lower speeds in turn lanes (no thru traffic)
  – Lower volumes in turn lanes
  – Creates refuge island opportunities

• More difficult on transit corridors.
MTCAT Implementation

• Can be used to evaluate potential crosswalk designs and treatments.
• Mostly a thought exercise for what works and what doesn’t.
• Makes a strong case for:
  – “Un-marking” uncontrolled multi-lane xwalks
  – Not pressuring pedestrians to begin crossing
  – Active warning devices
  – When yielding, do so further in advance
  – Pedestrian education (check each lane)
Questions
Links

- http://www.twincities.com/2014/10/30/theyre-called-multiple-threat-crashes-now-how-do-we-prevent-them/
- http://tcsidewalks.blogspot.com/2016/05/another-predictable-tragedy-in-maryland.html